Validation of HIRDLS observations of tropospheric cirrus and Polar Stratospheric Clouds

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Outline of Presentation

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Aerosol observations

- Aerosol near the tropopause
- Stratospheric aerosol background

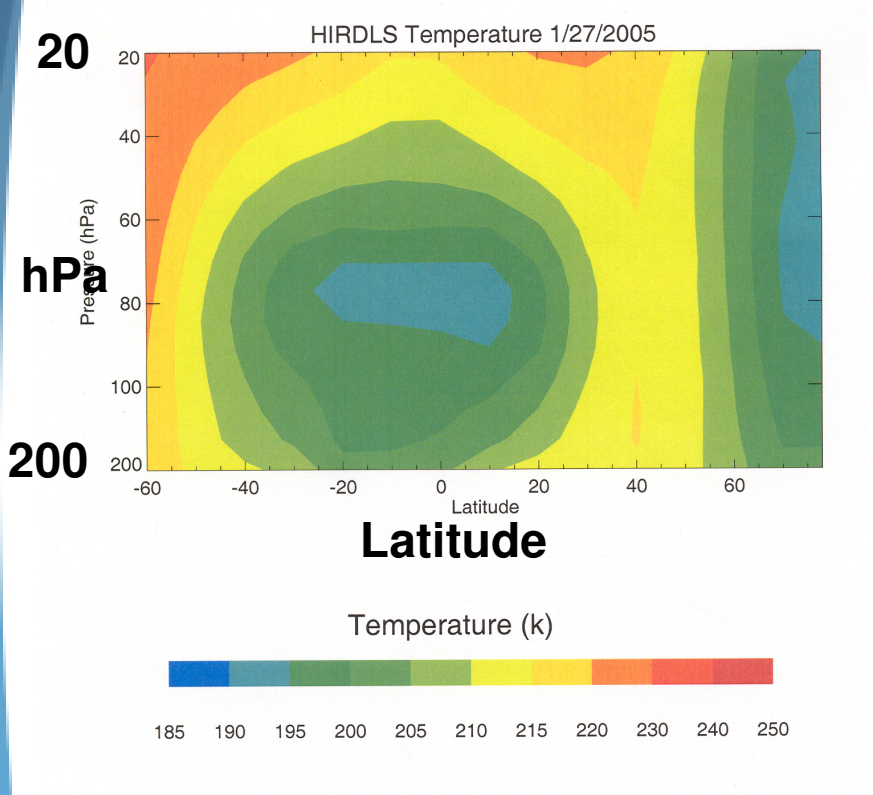
Cloud observations

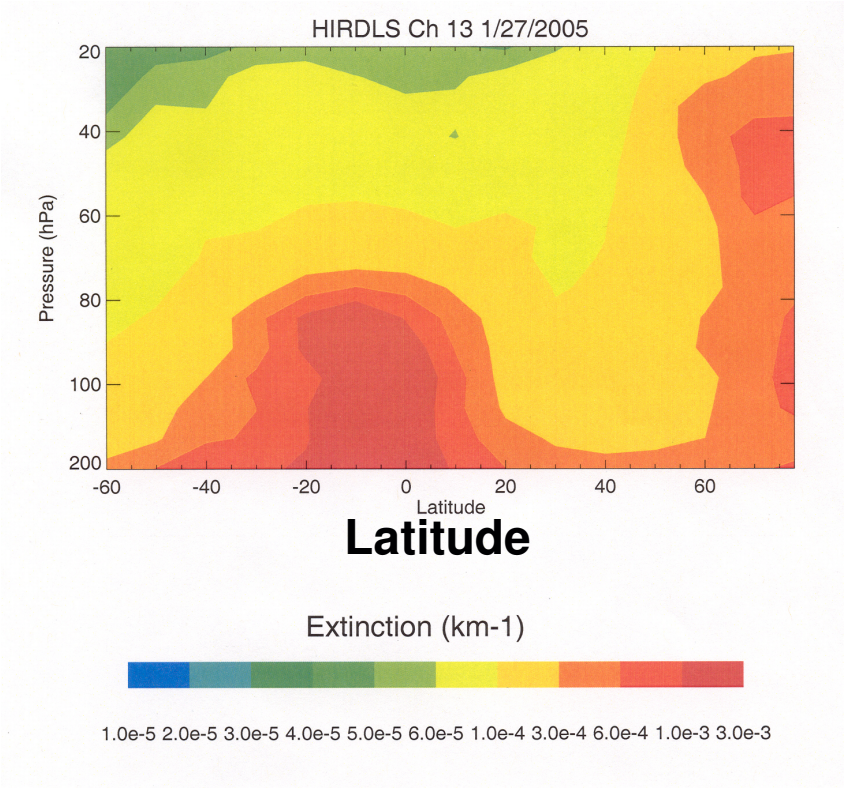
- Polar Stratospheric Clouds
- Opaque clouds in the troposphere
- Subvisual cirrus in the troposphere

Demonstrate that

- HIRDLS can detect these cloud/aerosol types
- Geophysical structure and extinction values are very reasonable

One Day's Retrieval 1/27/05





HIRDLS Temperature

HIRDLS Extinction

Aerosol near the tropopause

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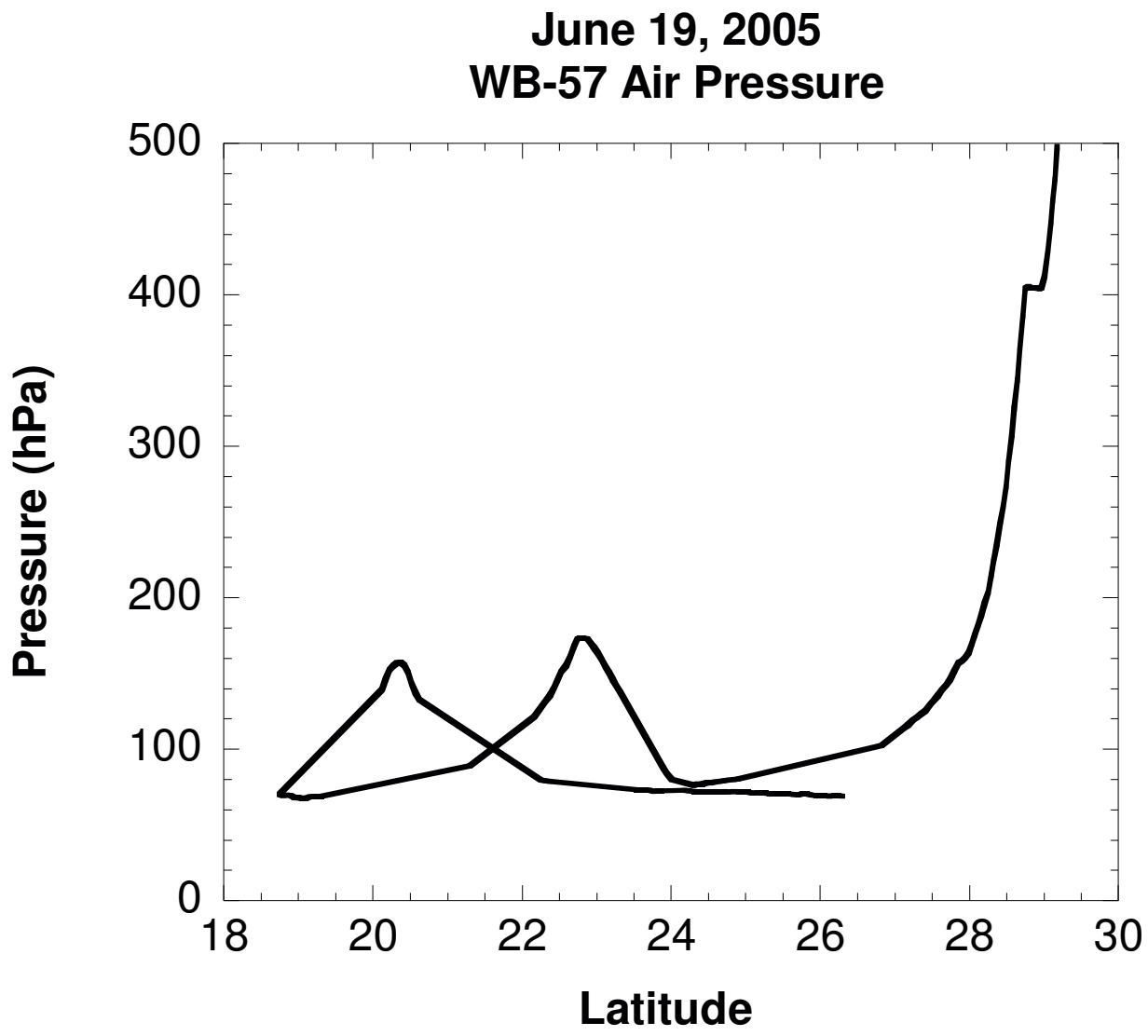
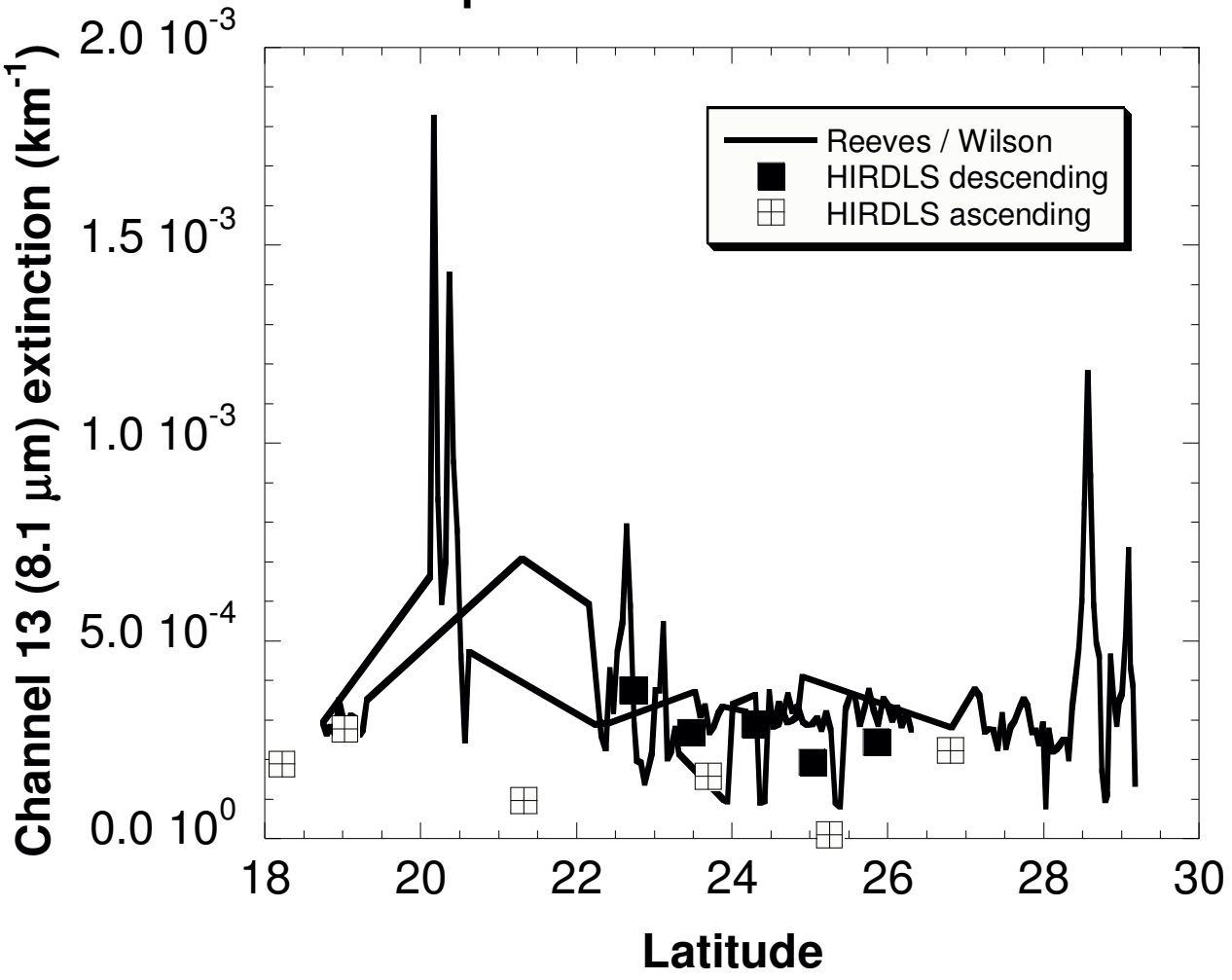
Use Reeves/Wilson (Denver University) aerosol particle size measurements to calculate extinction at HIRDLS aerosol/cloud wavelengths (channels 1 ,6, 9, 13, 19 at 17.3, 12.0, 10.8, 8.1,7.1 μm).

Use particle size distributions from June 19 WB-57 flight. Will focus on observed and calculated extinction for 22 N - 26 N (i.e. where thick clouds are not present, and flight pressures are near 100 hPa)

Note that the channel 13 wavelength is near the peak of the sulfate aerosol extinction spectrum.


June 19, 2005
WB-57 Air Pressure
Pressure (hPa)
500
400
300
200
100
0
18
20
22
24
26
28
30
Latitude

June 19 WB-57 Flight
Reeves / Wilson (DU) aerosol size distributions
Comparison to HIRDLS extinction

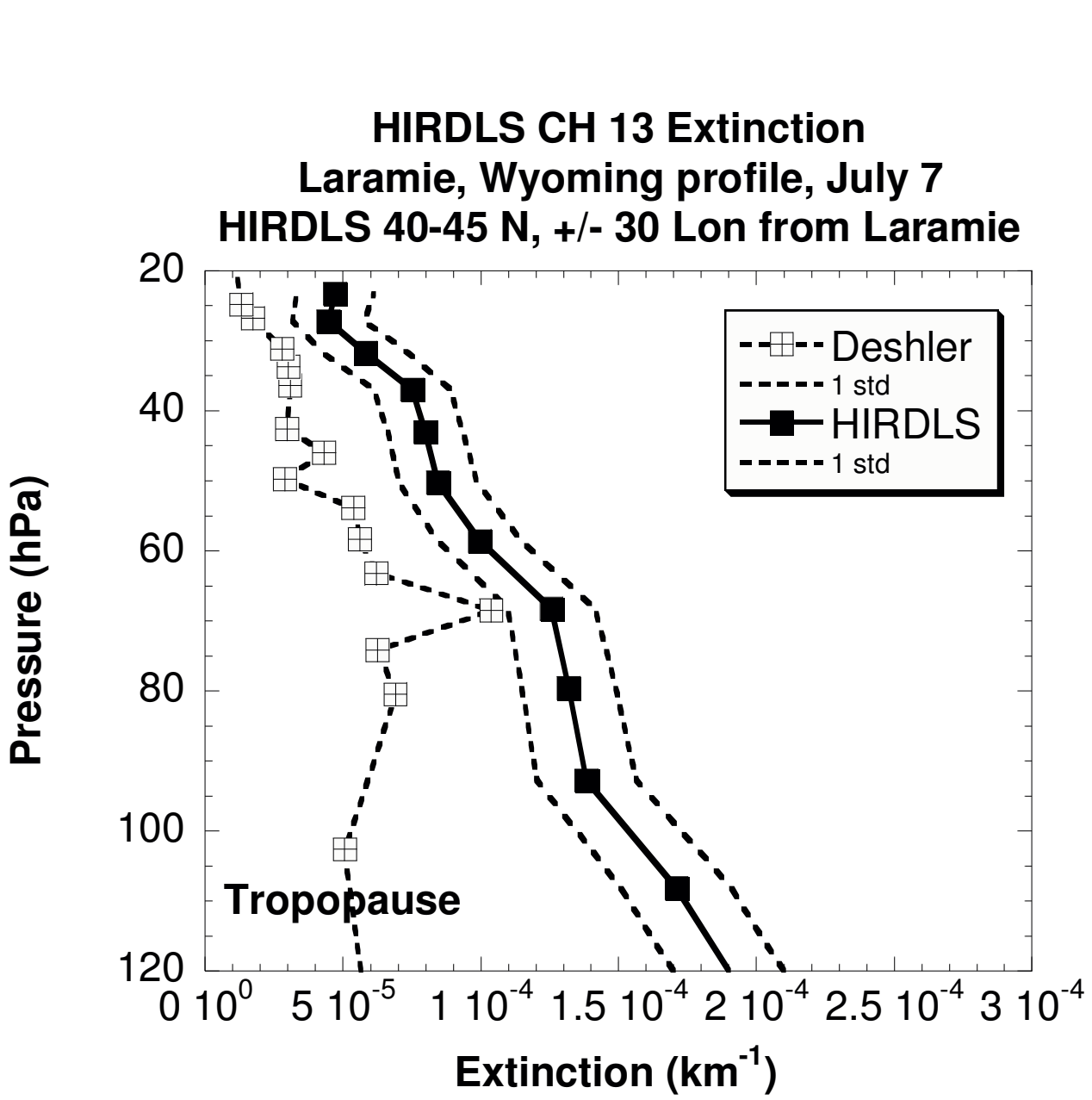


HIRDLS Channel 13 data

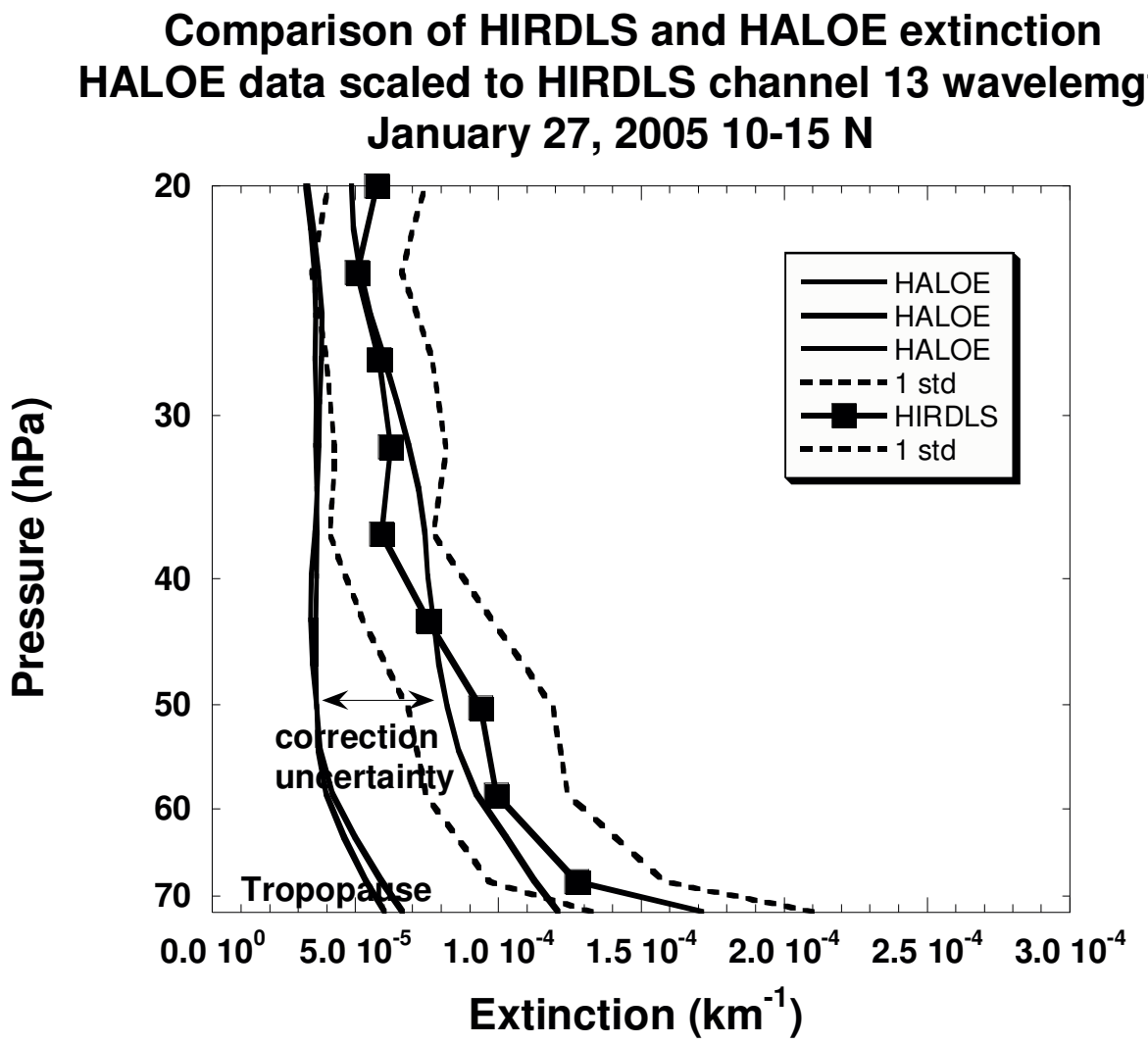
Stratospheric Aerosol Background

Will compare HIRDLS retrieved aerosol extinction to that calculated from in-situ particle size distributions measured by Terry Deshler over Laramie, Wyoming on July 7, 2005.

Will compare HIRDLS retrieved aerosol extinction to that observed by the HALOE experiment. This requires a transformation (wavelength correction) of the HALOE data to that of Channel 13 of the HIRDLS experiment.


HIRDLS CH 13 Extinction
Laramie, Wyoming profile, July 7
HIRDLS 40-45 N, +/- 30 Lon from Laramie
Pressure (hPa)
20
40
60
80
100
120
Deshler
1 std
HIRDLS
1 std
Tropopause
0 10^0
5 10^-5
1 10^-4
1.5 10^-4
2 10^-4
2.5 10^-4
3 10^-4
Extinction (km^-1)

HIRDLS – HALOE Comparison



Polar Stratospheric Clouds

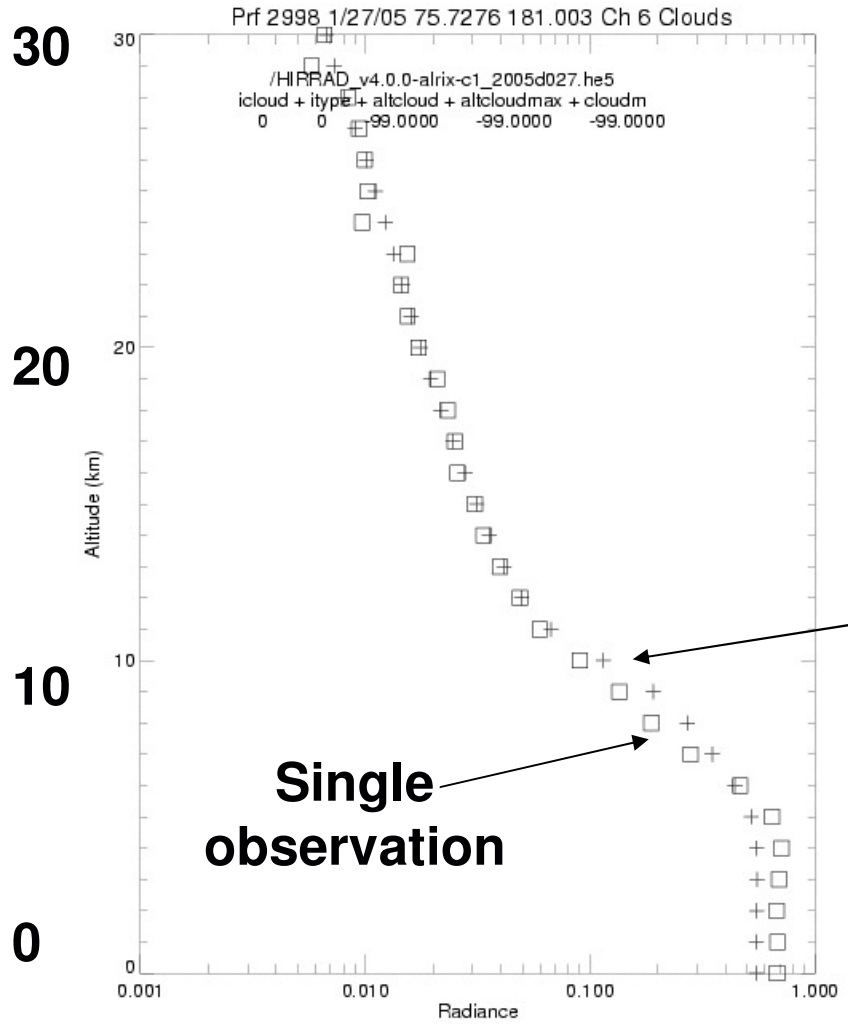
Will present examples of PSC radiance profiles

Will demonstrate that when POAM detects a PSC, so does HIRDLS

Will show that PSCs are observed where they should be – at cold stratospheric temperatures.

Will compare POAM and HIRDLS extinction profiles.

Example of non-PSC observation



Altitude (km)

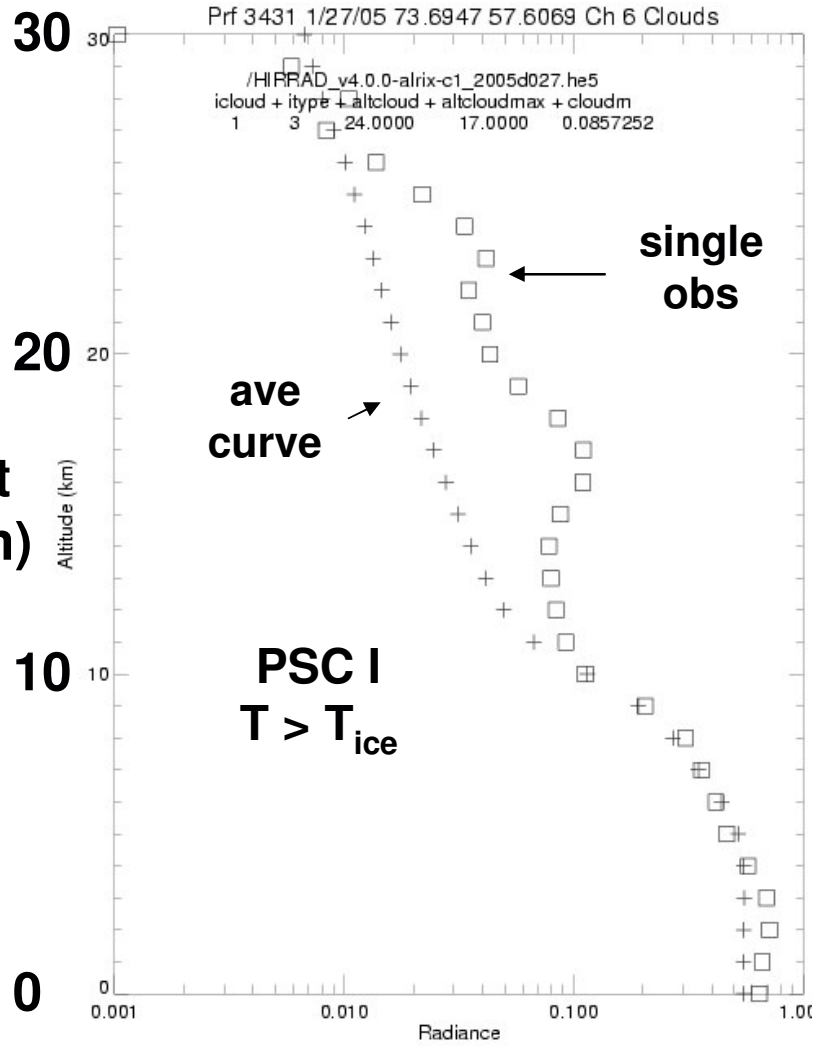
Observation is outside the vortex

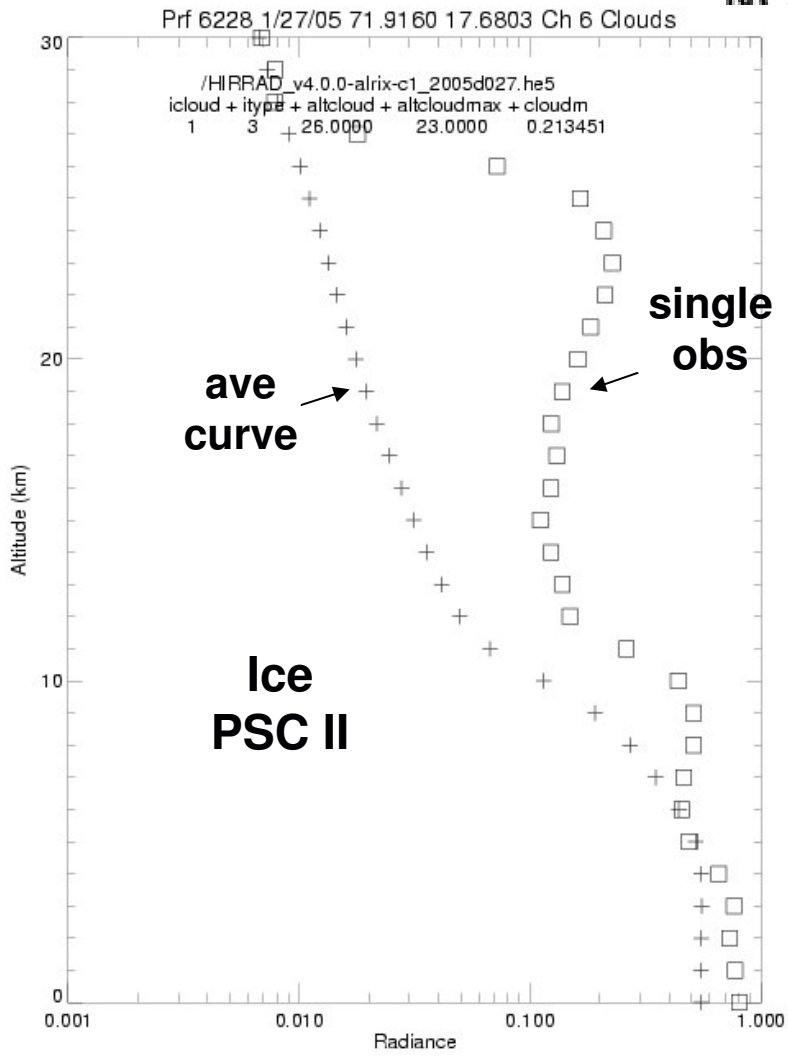
Average curve

Single observation

log Radiance

Examples of PSC radiance profiles





Alt (km)

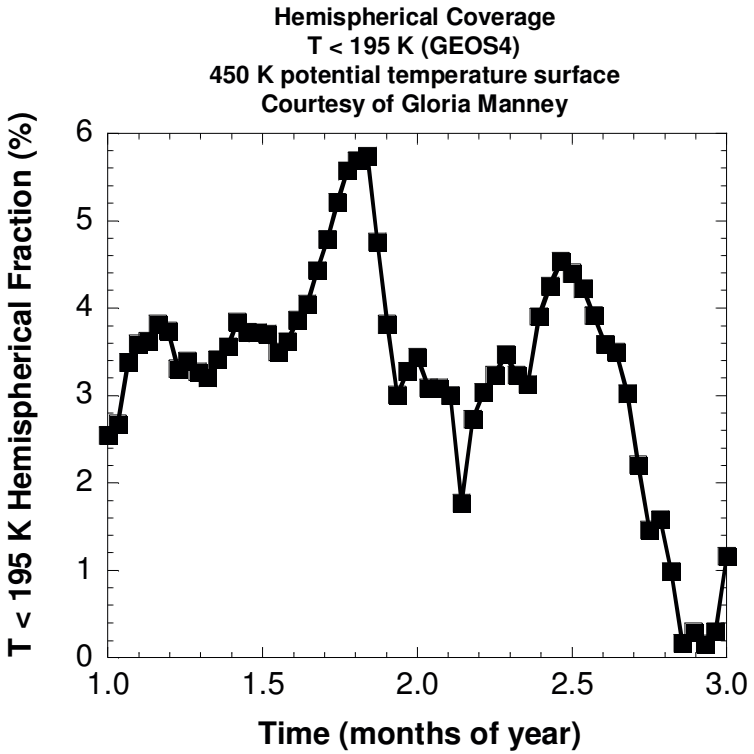
log Radiance

log Radiance

1/27/05

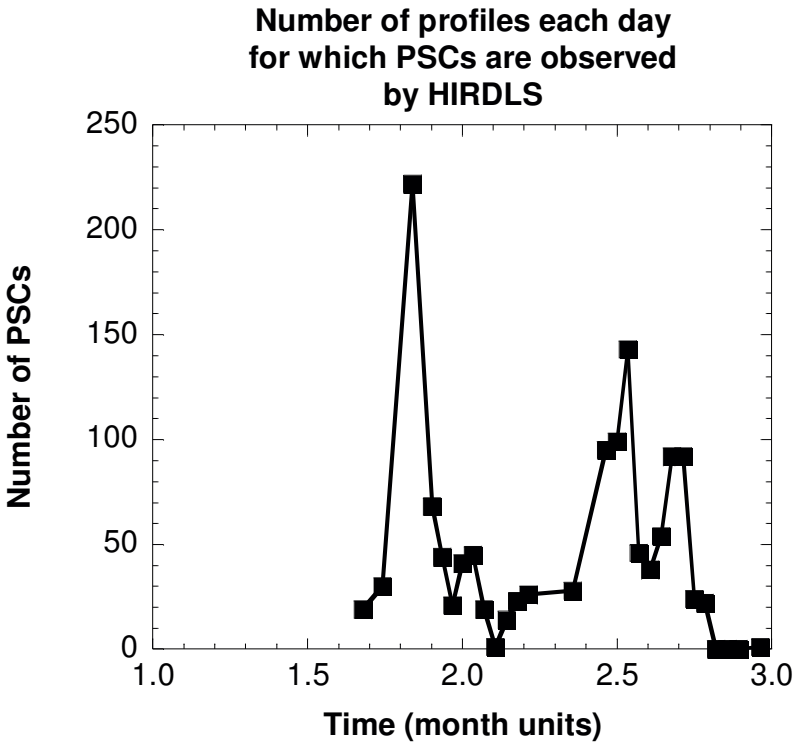
PSC profiles observed per day

Vortex % Coverage



Jan **Feb**

HIRDLS, PSCs / day



Jan **Feb**

HIRDLS began observations Jan 20

PSCs Observations on January 27

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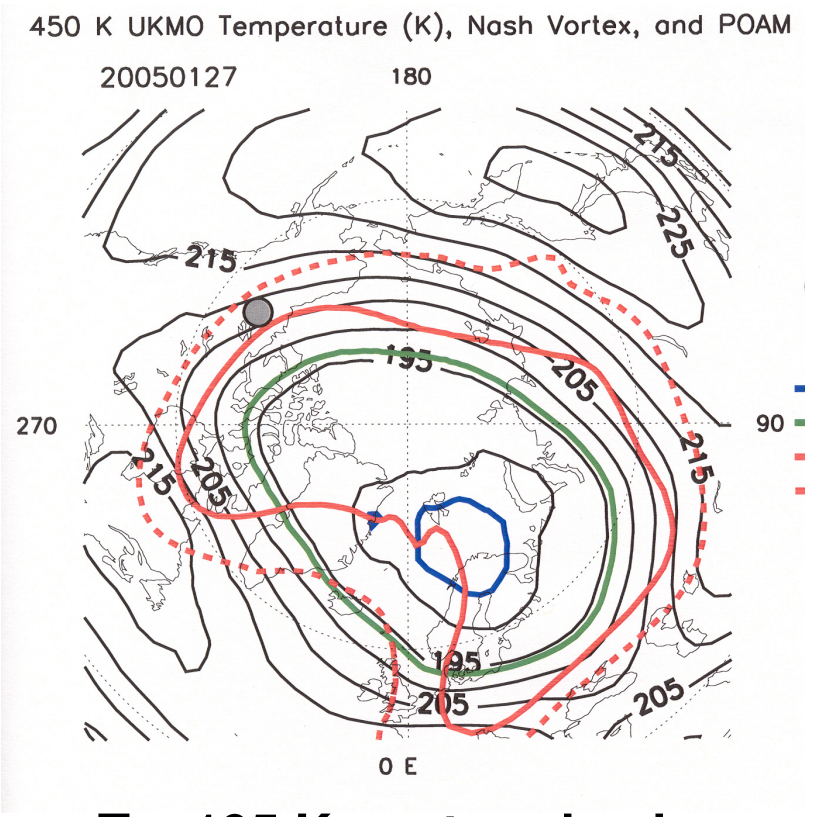
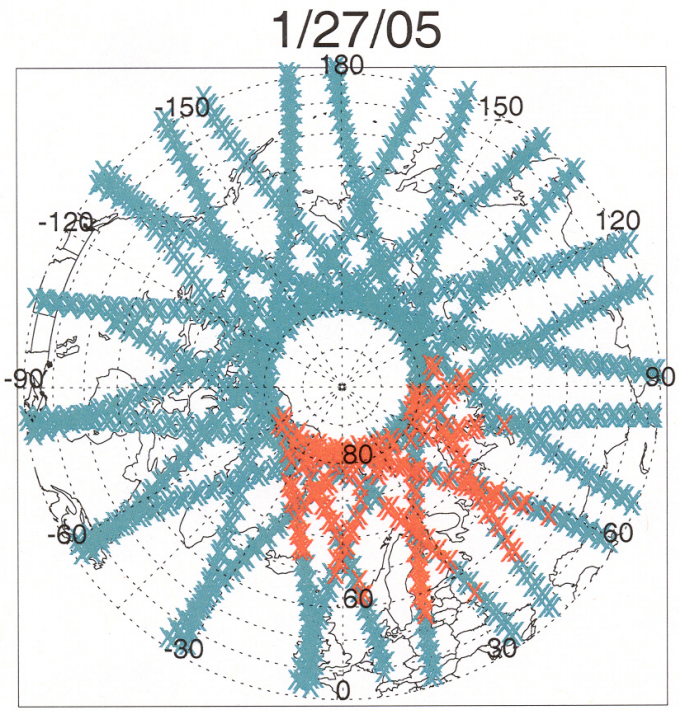
450 K vortex geometry



T < 195 K contour is given by the green line, Tice by the blue line, Nash vortex by the red line.

HIRDLS Observations



PSCs are denoted by the red crosses, and blue crosses are non-PSCs

Locations of PSCs 1/27/05
Pressure vs Longitude Graph

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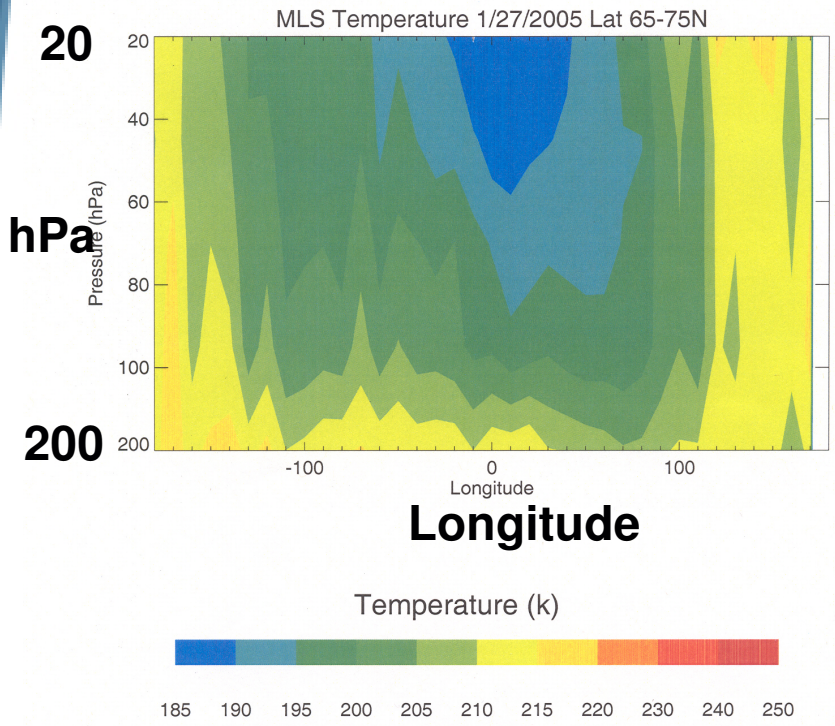
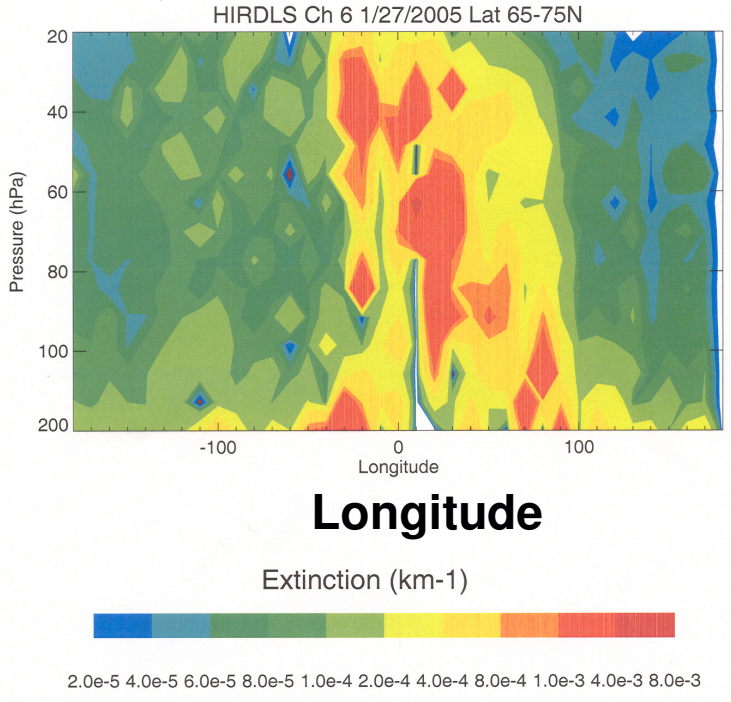




MLS Temperature

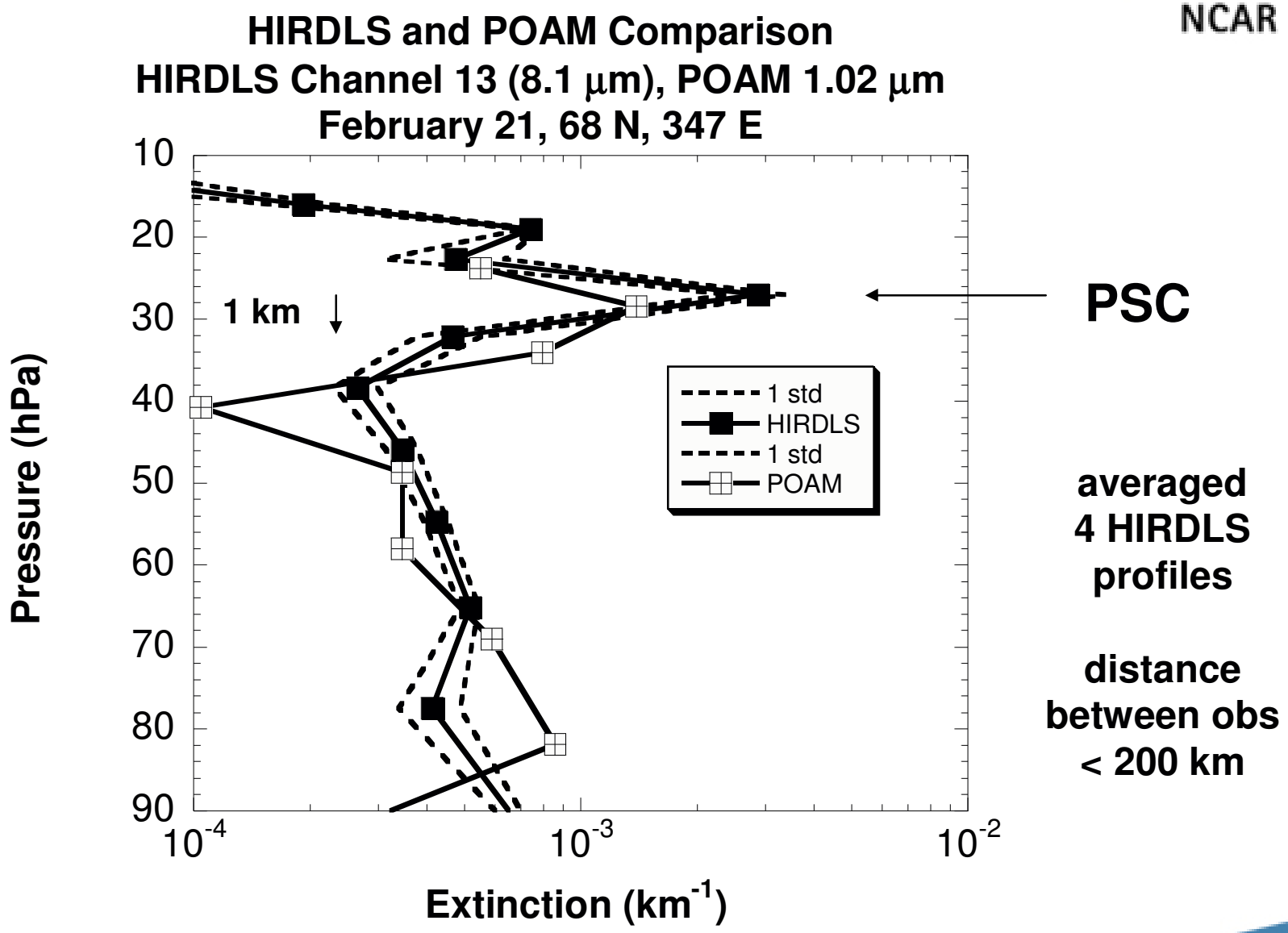
HIRDLS Ch 6 Extinction

Identification Accuracy

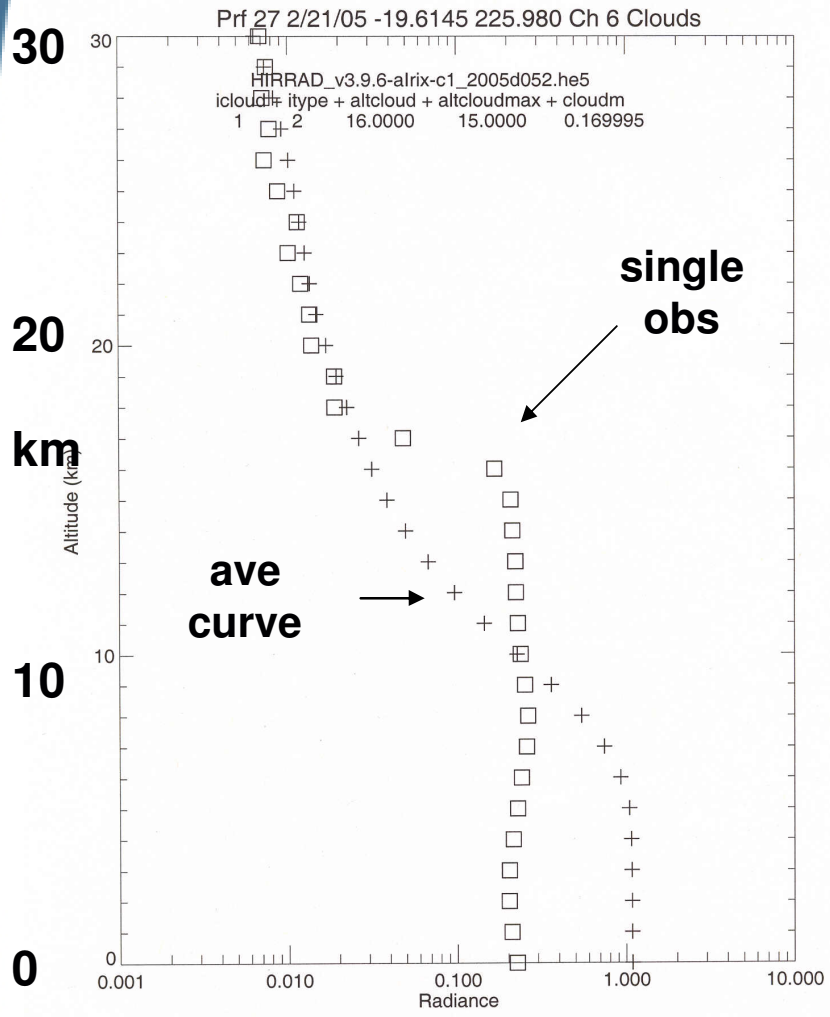
POAM observed PSCs February 15 -21

POAM / HIRDLS intercomparison

When POAM observed PSCs, HIRDLS detected PSCs (in agreement with POAM) 85% of the time.

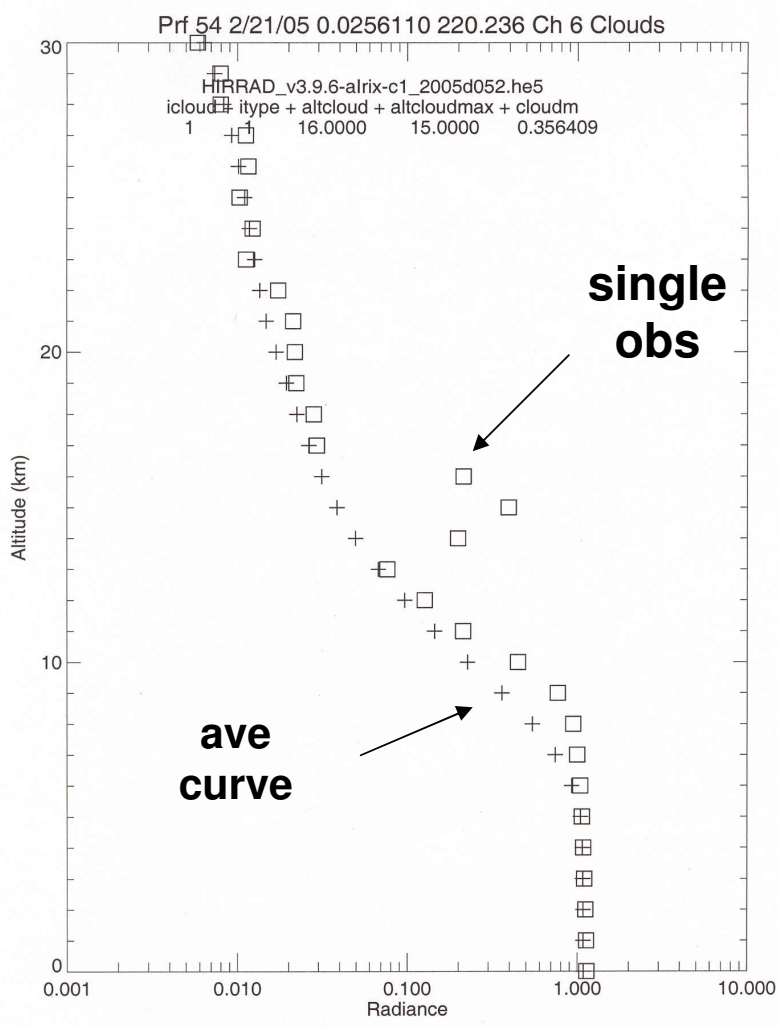

HIRDLS and POAM Comparison
HIRDLS Channel 13 (8.1 μm), POAM 1.02 μm
February 21, 68 N, 347 E
Pressure (hPa)
10
20
30
40
50
60
70
80
90
1 km
1 std
HIRDLS
1 std
POAM
10^{-4}
10^{-3}
10^{-2}
Extinction (km^{-1})
PSC
averaged
4 HIRDLS
profiles
distance
between obs
< 200 km

Tropospheric Clouds
Opaque and Subvisual Cirrus



log rad

Opaque



log rad

Cirrus Layer

km

Opaque Tropospheric Clouds Associated with Deep Convection

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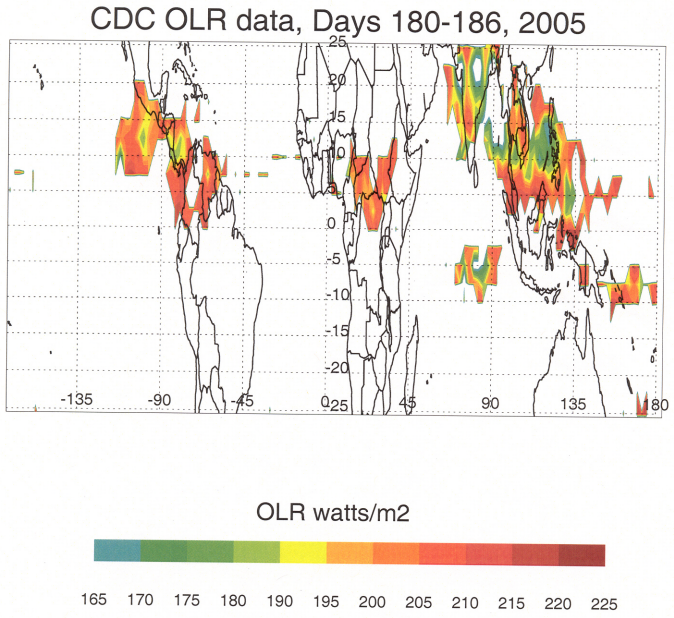
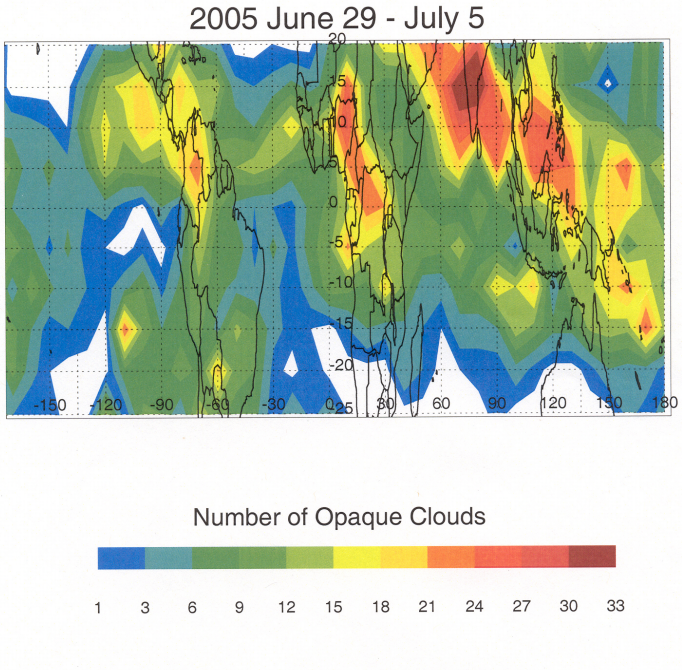
CDC OLR Data



Deep Convection
OLR < 220 watts / m²

HIRDLS



Locations of Opaque Clouds

Locations of Cirrus Layers

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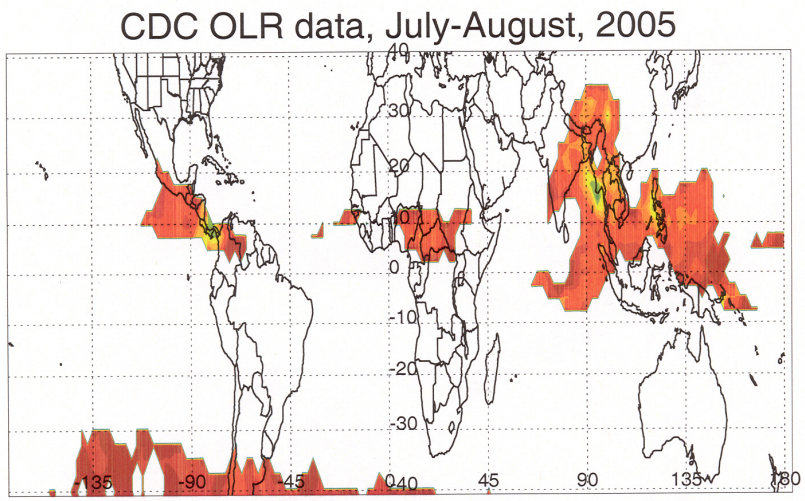
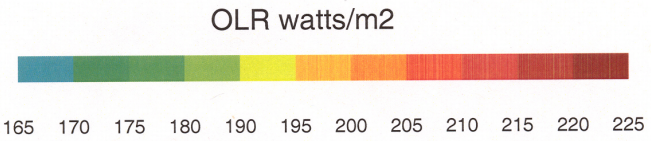
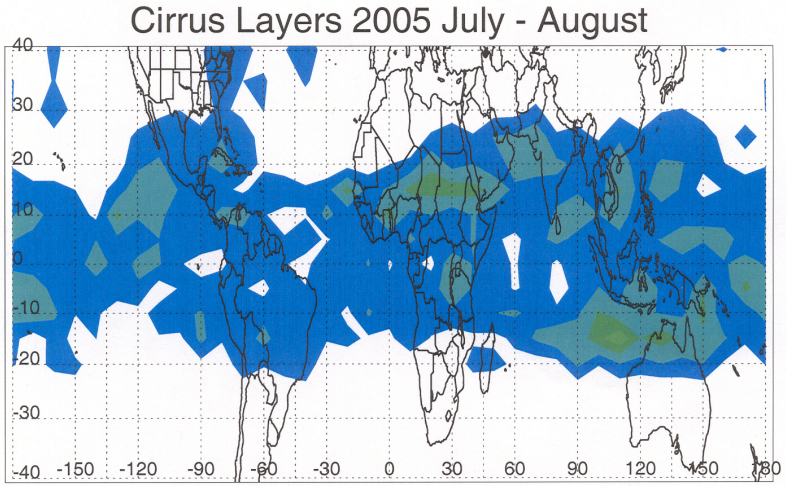
CDC OLR Data

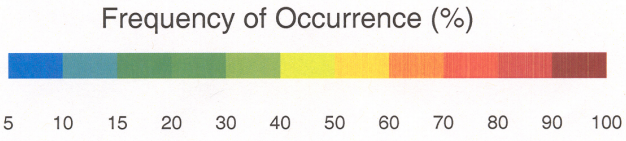




Deep Convection
OLR < 220 watts / m²

HIRDLS





Locations of Cirrus Layers

Subvisual Cirrus Clouds Involved in UT/LS Dehydration Processes

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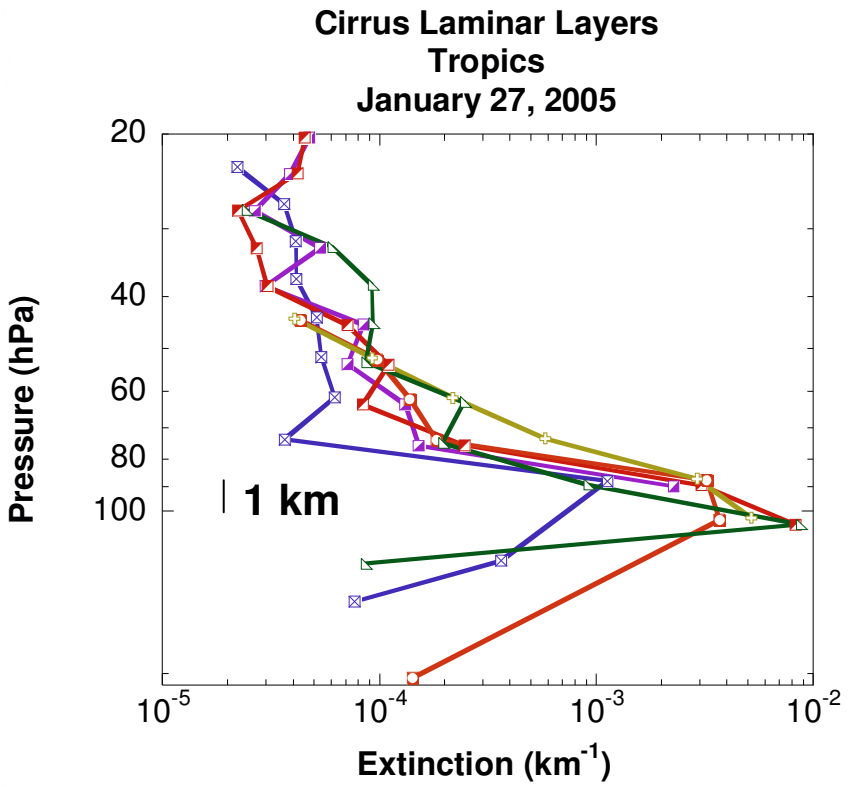
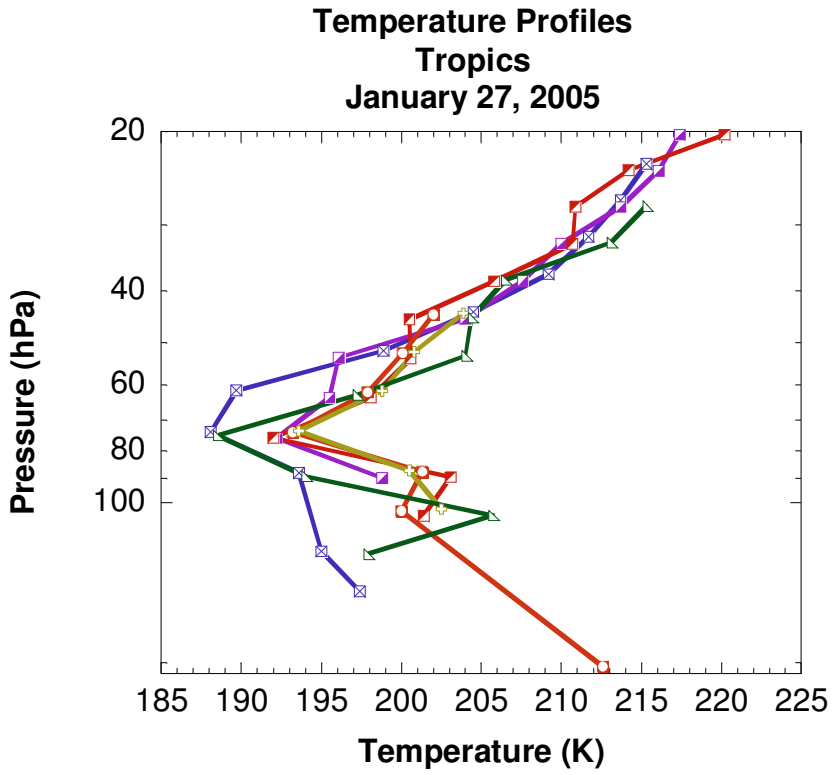
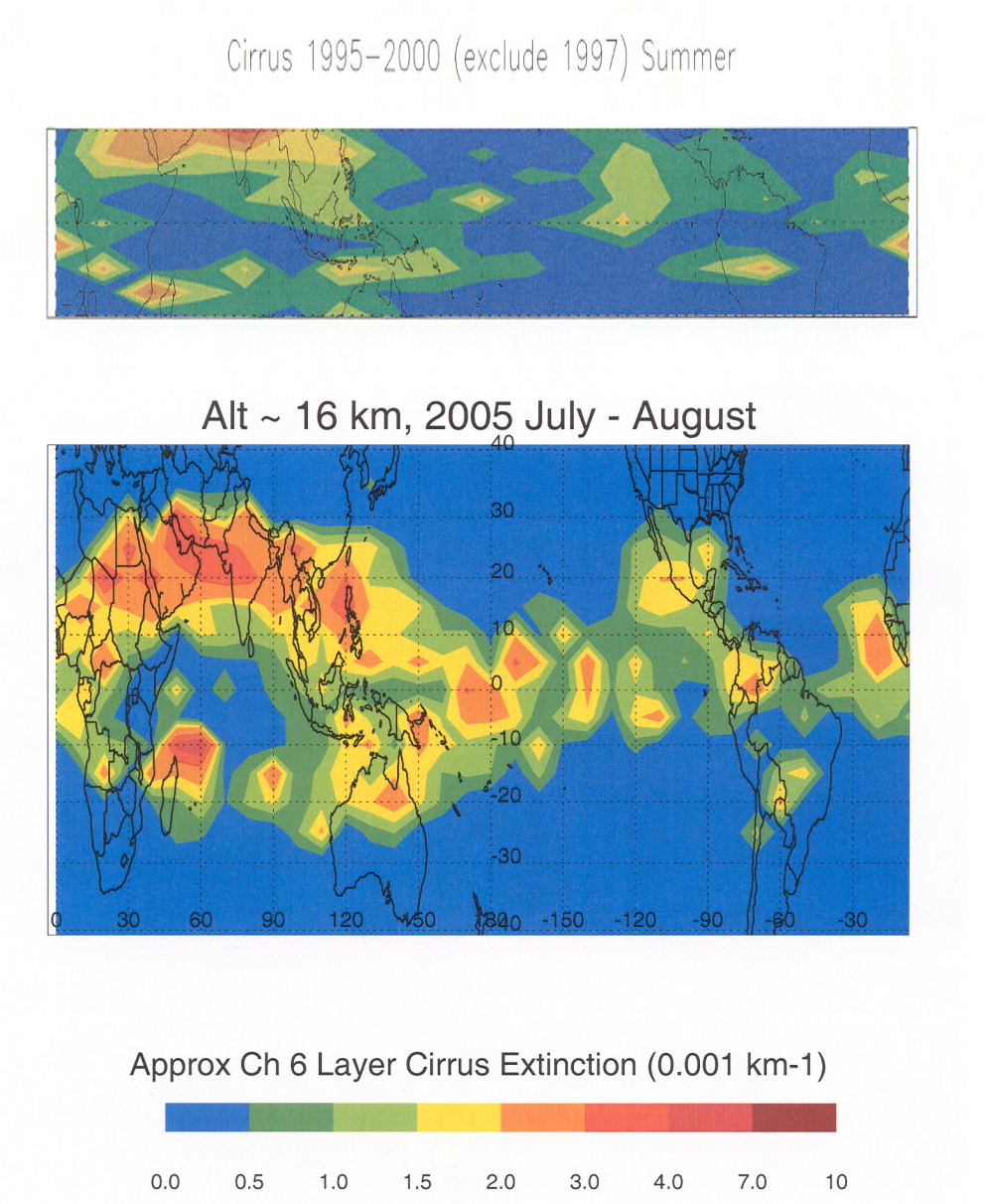




Comparison to Climatology



HALOE

HIRDLS

~ 100 hPa

Conclusions

HIRDLS can measure:

a) **Stratospheric background aerosol**

b) **Polar Stratospheric Cloud extinction profiles**

c) **Extinction profiles of subvisual cirrus layers**

These measurements are unique AURA capabilities